

**BUTLER (G. R.)**  
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The Methods and Value of Super-  
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phylaxis of Pulmonary  
Phthisis.

BY

GLENTWORTH R. BUTLER, A. M., M. D.,  
BROOKLYN,

Physician to the Methodist (Seney) Hospital; Lecture on Pub-  
lic Hygiene, Physiology, and Nursing, Pratt Institute;  
Vice-President of the American Climatological  
Association.

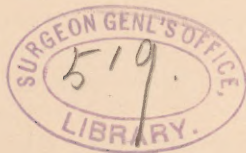
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THE METHODS AND VALUE OF  
SUPERVISED EXERCISE IN THE PROPHYLAXIS  
OF PULMONARY PHTHISIS.\*

By GLENTWORTH R. BUTLER, A. M., M. D.,

BROOKLYN,  
PHYSICIAN TO THE METHODIST (SENEY) HOSPITAL;  
LECTURER ON PUBLIC HYGIENE, PHYSIOLOGY, AND NURSING, PRATT INSTITUTE;  
VICE-PRESIDENT OF THE AMERICAN CLIMATOLOGICAL ASSOCIATION.

PULMONARY tuberculosis is essentially a disease of defective nutrition. Its immediate microbial factor is universally acknowledged, but underlying the bacillary growth is a certain vulnerability of the tissues. Pathogenic germs require definite conditions for their growth. If the necessary conditions are absent, growth and multiplication cease.

Without question, the tissues of the human body vary in their susceptibility to the advances of the tubercle bacillus. This susceptibility varies in different individuals, and in the same individual at different times. The proof is so obvious that it simply requires mention. The large majority of civilized individuals are exposed to the entrance

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of the bacilli into different parts of the body, but only the minority, sadly large, to be sure, surrender to the invasion. The fact that pulmonary tuberculosis occurs in a given organism, develops to a given point, and then under changed conditions and environment is arrested, constitutes proof positive of variance in the resisting power of the individual.

Improvement or arrest can not be credited to specific medication, for specific medication in phthisis is as yet a chimera. A consideration of the anatomical situation of the bacilli in this disease should at once dispel any hope of direct germicidal treatment. Imbedded as they are in thick mucus, fibrous tissue, and epithelial *débris*, and situated somewhere at the ends of an intricate system of branching tubes, which constantly grow smaller, the mere mechanical difficulties are insuperable. This statement applies not only to nebulized solutions, but to vapors as well. The only way by which vapors enter the air cells is by diffusion, and the mere surface contact of a gas is not sufficient to act as a germicide. The well-known difficulty of sterilizing the external surface of the body in surgical practice bears upon this point. The hard scrubbing and prolonged soaking required is an interesting commentary on the futile attempts at local pulmonary disinfection which are still made.

The nature of immunity—natural, lost, or reacquired—is still a mystery. The terms used to characterize it show themselves a mere begging of the question. Predisposition, proper soil, hypotrophy, vulnerability, involve various hypotheses and somewhat metaphysical speculations, which, while of extreme interest, can not be claimed to represent exact truth. Biochemical or vital forces have not been weighed or measured except as to their manifestations. Dynamic variations of cell power are not yet visible to the

microscope, except in their grosser results. Granting that the essence of life power is unknown, it is nevertheless a convenience to use the terms mentioned.

A certain vulnerability, then, is antecedent to the development of pulmonary tuberculosis. On analysis, all measures directed toward its prevention or arrest act directly or indirectly toward improving the resisting power of the tissues. An exception must be made of those means which tend to lessen the chances of infection—viz., the destruction of bacilli laden sputa, disinfection of infected rooms, houses, or food, and the limitation of prolonged and close contact with the consumptive.

The measures employed for the prevention or arrest of phthisis may be classified as follows, omitting any form of quarantine or disinfection :

Climate, abode, and outdoor life.

Medication, general and local.

Personal hygiene and habits of life.

Exercise, general and special, with its corollary, rest.

Diet.

I have no intention of specifying the relative importance of these lines of treatment. It is not safe to neglect any one of them, so far as compatible with the circumstances and condition of the patient. Any device or measure that will strengthen and fortify the cells and tissues of the body should be carefully sought after and employed if practicable.

Realizing thoroughly the importance of broad treatment in this as in other diseases, I beg to call particular attention to one of these items—exercise.

I am very firmly convinced from fairly large personal observation that regulated exercise as a therapeutic resource is neglected by many physicians. This neglect does not arise from ignorance, because this subject has been

fully and scientifically exploited in various periodical and systematic publications. It is more akin to the feeling with which one regards some of the English classics—as most worthy of regard, but not suited for practical everyday use.

In prescribing exercise the supreme importance of exact attention to detail should be emphasized. It is important in all things, but a matter of necessity in this. The title of a paper by Weir Mitchell may well stick in the mind. "Precision in the Treatment of Chronic Disease" is a most felicitous phrase, and beautifully descriptive of the mental attitude which should exist in the mind of the physician who is treating pulmonary tuberculosis, imminent or acquired.

There are two classes of cases in which exercise is of a peculiar value :

1. The pretubercular status.
2. Incipient tuberculosis.

The boundary lines can not be laid down with absolute accuracy. The personal equation of the observer is a factor in assigning an individual case to its proper class.

Broadly speaking, the first class comprises those in which the conditions presented give rise to a reasonable probability that phthisis will develop; the second class those in which the signs and symptoms are such as to show beyond peradventure that tuberculosis exists, but only to an extent that warrants one in terming it "incipient." The classification is a good working formula, if not scientifically correct.

The symptoms and signs, in greater or less number, and to a greater or less degree, presented by the pretubercular status are : Progressive loss of weight, languor, dyspnoea, irregular or absent menstruation, anorexia or capricious appetite, insomnia, tubercular family history, neuras-



thenia, poor chest expansion, deformity of chest—viz., non physiological asymmetry or depressions—slight cough, afternoon temperature normal, or 99° F.; finally, absence of decisive pulmonary physical signs.

The symptoms and signs of the second class—incipient phthisis—are so familiar that it is unnecessary to recapitulate them. Hæmoptysis is an event that is well nigh pathognomonic. The physical signs may be so slight as to require the most careful and repeated examinations for their detection or so well marked that the diagnosis is at once indubitable. The history may include a previous pulmonary or pleuritic affection. The clinical picture should not exceed in its coloring the limitations understood by the term “incipient.”

Exercise may be either general or local. The benefits of general exercise may be briefly mentioned: Increase in bulk and strength of muscles, stronger action of heart, improved circulation—arterial, venous, and lymphatic; increase of respiratory capacity, better action of skin, increased depurative functions, improved sleep, appetite, and digestion, and last, but by no means least, a decided bettering of the nervous system. The motor mechanisms of the body are not solely muscular, they are neuro-muscular. Regulated action of the muscles involves the correlative activity of the nerve centers from which they receive their stimuli. Training the nervous system by muscular exercise most certainly improves its functional capacity. When one recalls its varied, complex, and important activities it is readily seen that results of great value may ensue.

This paper is not intended to deal further with the large subject of general exercise, but to treat more particularly of local or special exercise, which in this connection consists of measures conveniently termed “pulmonary gymnastics.”

The direct effect of pulmonary gymnastics is to

strengthen the muscles of inspiration and expiration; to increase the size of the thorax and thereby add materially to the respiratory capacity; to increase the ease and fullness of the pulmonary circulation, and to promote the interchange of gases and the general supply of oxygen to the tissues. According to the rule that full use of any organ adds to its functional energy and structural development, it is properly said that pulmonary exercise brings the vital force of the lungs to its maximum. "Maximum vital force of the lungs" means that the cells of the various tissues composing the lungs are brought to the highest attainable perfection of structure and function, so far as this is dependent on their full and proper use.

The exercises which may be properly termed "pulmonary" are those which bring into special action the muscles of inspiration and expiration, ordinary and extraordinary, and also tend to place the head, neck, shoulders, and thorax into such positional relations that the expansion of the lungs is facilitated and increased. The various modes of pulmonary gymnastics may be classed under the following heads:

Singing and elocution lessons and practice.\*

Use of wind instruments.

Deep breathing, alone.

Running, climbing, brisk walking, and sports which accelerate the breathing.

Use of compressed or rarefied air, and their combinations.

Military setting-up drill.

Supervised exercises, especially adapted to improve respiratory capacity.

Lessons in singing and elocution involve deep inspiration and regulated expiration. So also does the use of

\* Suggested by Dr. A. H. Smith (personal letter).



wind instruments. To those who enjoy the practice of these arts there is opened a pleasing and efficacious method of increasing the respiratory capacity. These means are not employed to the extent that is desirable. Practice of this kind has the advantage of securing the willing and persevering adherence of the patient.

Deep breathing alone, repeated a number of times during the day, is very useful, but the direction so to do is usually honored in the breach rather than the observance.

Running, climbing, and fast walking indirectly increase the breathing power. All these, especially running and climbing, are adapted for comparatively few cases, because of the very decided effort and strain which they entail. Moreover, these efforts are apt to be ill-regulated and injudiciously severe. They should never be prescribed without the most minute directions as to time, length, and severity.

Aerotherapy, or the use of air, rarefied or compressed, in varying combinations, is a valuable resource. There is a great variety of apparatus, both simple and complicated, for use in this connection. Some of them aim at an artificial climatotherapy, with differing conditions of density and moisture. Others simply interpolate varying degrees of resistance during the acts of inspiration and expiration. Ordinary breathing tubes and wind instruments ought properly to be classed under this head. There has been much inconclusive writing on this subject. Many of the statements advanced by various observers have a largely speculative character, and do not appear to be based upon experimental findings. There is a lack of control experiments upon the comparative effects of breathing compressed and rarefied air, and forced breathing without apparatus. The relative permanency of these effects is also an open and very important question.

Certain portions of the military setting-up drill are useful in promoting proper carriage of the head, neck, and thorax. Some of the movements as usually practiced are more violent than is desirable for persons not in full vigor of health.

*Supervised Exercise.*—Under this designation I refer to exercises of various kinds, graduated from time to time to suit the varying requirements of a given case, and practiced regularly under the guidance of a competent instructor, lay or medical. This method is by no means new, but has proved of sufficient value in my own work to deserve more than a passing notice. In most of the larger towns and cities it is quite possible, after a little search, to find a competent man or woman, graduated from a reputable school of physical culture, who can be trusted to do this line of gymnastic work. It should be understood that the entire course of treatment is carried on under the general direction of the physician.

The methods pursued are as follows :

Hygienic dress is insisted on, this generally being requisite in the case of female patients.

Regular daily work is required, with simple exercises to be taken at home.

Measurements and tracings of the thorax are made, and the vital capacity ascertained by the spirometer. These records, made at the beginning of treatment, are valuable for purposes of comparison with similar records made at subsequent periods.

After a careful study of the patient's general strength and pathological condition, a certain set of exercises is prescribed. The effort is to adjust the prescription exercise so as to fulfill the indications in the given case. These indications may be :

To correct deformities, depressions, and pathological asymmetries of the thorax.

To increase chest expansion and vital capacity.

To secure permanently deeper breathing by training the neuro-muscular apparatus to habits of ampler rhythmic action.

All of these desirable results I have seen attained.

A certain amount of general exercise is usually given in order to secure the benefits acknowledged to result from it—viz., better appetite and digestion, sounder sleep, healthier condition of the skin and eliminative organs, and improved circulation. As the greater includes the less, a measurable degree of the benefit of general exercise is secured by pulmonary exercise alone.

A large variety of exercise is available, according to the patient's ability and the results desired. Movements may be active, duplicated, or passive.

An active movement is one accomplished by the patient without the aid of the operator.

A duplicated movement involves resistance to the operator on the part of the patient, or resistance to the patient on the part of the operator. The former is eccentric, the muscle being lengthened while contracting; the latter is concentric, the muscle being shortened while contracting.

A passive movement is performed by the operator, without effort on the part of the patient.

It will readily be seen that exercises of this kind may be graded by very small steps from those which are effortless to those which require more than ordinary strength to execute. Although there is great variation in the outside appearance of many of the exercises they have in common certain underlying aims :

1. To elevate the shoulders.

2. To draw back the clavicles and scapulæ, and thus by traction on the pectorals to elevate the ribs and expand the thorax.



3. To strengthen the muscles of ordinary inspiration, the diaphragm and intercostals; also the muscles of forced inspiration, the scaleni, sterno-mastoids, trapezius, two serrati, and rhomboids.

4. To strengthen the muscles of forced expiration (ordinary expiration being passive and non-muscular), mainly the abdominal and quadrate muscles.

The third indication—to strengthen the muscles of inspiration—may be considered the most important. It is very desirable that the muscles of the neck, which have been mentioned above, should receive attention. If the muscles running down from the cervical spine to the upper ribs and shoulders are strong and of a good tonus, valuable aid is given to ordinary inspiration.

An example of a passive movement: Patient sitting, operator standing behind; the operator's hands are placed under the axillæ, patient leaning back; the shoulders are then drawn upward and backward, patient inhaling; then downward to the sides, patient exhaling.

An active movement: Patient, standing, extends arms above head, raises body on toes, inspiring at the same time; then down on heels, exhaling.

A duplicated movement: Patient sitting; operator, standing behind, grasps patient's hands, draws the arms vertically upward against patient's resistance; then patient draws arms down against operator's resistance. This is practically Sylvester's method of artificial respiration.

A good operator will begin moderately; will watch the patient carefully to avoid undue fatigue; will vary and add to the movements as strength is regained or acquired. It is a progressive method.

I beg to report in synopsis four illustrative cases out of a series in which supervised exercise was employed as one of the items of treatment:

CASE I.—Physician's daughter, aged twenty-two years. Successive attacks of influenza; no hereditary taint. Loss of flesh, dyspnoea, left chest pain, headache, unrestful sleep, poor circulation. Examination showed infraclavicular depression and asymmetry of thorax, slight relative dullness at left apex, weak respiratory murmur, and fine crackles on deep inspiration over same area. Fine crackles disappeared after a few deep respirations. Evening temperature, scant 99° F. Lung capacity considerably below normal.

*Treatment.*—General tonics, alimentation, hygienic dress (which was needed), light movements followed by massage.\* Light work at home. At the end of six weeks tracings showed depressions at left side of thorax nearly obliterated; measurements, that all diameters had increased; average gain in lung capacity, fifty cubic inches; pain gone; sleep normal; appetite above normal. Improvement permanent.

In this case the apices were catarrhal and non aerated. If tubercular disease was not present, it was at least imminent.

CASE II.—Also the daughter of a physician. Hacking cough for some weeks; evening temperature, 100° to 100·5°. Slight expectoration; slight dullness both apices, with scanty crackles and moderately harsh breathing, especially on right side, after making due allowance for physiological differences. Expansion poor. Treatment† and subsequent history like Case I, but longer continued.

CASE III.—A woman, aged twenty-four years. Hæmoptysis small, but extending over several weeks, with previous history of gradual failure of health. Indubitable physical signs of localized apex tuberculosis. Poor expansion and vital capacity. Medicinal treatment and alimentation were rather unsatisfactory until supervised exercise‡ was added. She remained in good health for a year, when worry and care for a father who died of very chronic phthisis caused a relapse (probable reinfection).

\* By Miss Marsh, of Brooklyn.

† Operator, Miss Lindley, of New York.

‡ By Miss Marsh.

The way opened for her to go to California, where she now is, and doing well.

CASE IV.—A woman, aged twenty-five years. First seen four years ago with localized right apex tuberculosis of at least eight months' standing. Weight, one hundred and eight pounds. Afternoon temperature running  $101^{\circ}$  to  $102^{\circ}$ . Extreme weakness, dyspnœa, anorexia, and insomnia. So well marked was the disease and so unpromising her condition that a considerable sum was paid her by a benefit society, after a careful examination by three physicians, on the ground that her disease would prove inevitably fatal. In this opinion I fully concurred. She was first placed under the "rest cure"—rest, massage, electricity, and superalimentation. Six weeks of this brought her temperature down and her weight up. Careful management and graduated exercise under my own supervision caused a slow arrest of her disease, and to-day she weighs one hundred and forty-eight pounds, a gain of forty pounds, and the apex lesion, while perceivable, is quiescent.

In this case the exercises were under my personal direction, because at that time I was unacquainted with the great help to be afforded by a competent operator. The patient was unusually tractable and conscientious in carrying out detailed directions. I have found the "rest cure," with or without isolation, an extremely valuable resource in beginning the treatment of somewhat advanced cases.

A distinct advantage of supervised exercise is the moral effect on the patient by which the regular and persistent use of this means of treatment is assured. Without the stimulus of expected attendance on the operator, prescribed exercises are very apt to be neglected. Under ordinary circumstances most of us can not afford the time required to properly administer and supervise such exercises. Instruction should be definite, personal, and repeated. Herein lies another value of the trained operator.

The objects of supervised pulmonary exercise, as before formulated, are substantially similar to those of mechanical



aerotherapy. The comparative utility of each deserves a word of discussion. Judging from personal observation of cases submitted to both methods, I am convinced that the effects in permanently strengthening the muscles of respiration and increasing the chest capacity are more marked with supervised exercise than with aerotherapy. This statement applies only to the pretubercular and incipient stages. Permanence of effects is obviously extremely desirable. The superiority of one method over the other in this respect is founded upon the differing quantitative muscular efforts required. In pneumotherapy the following combinations may be attained by suitable mechanical devices:

Inspiration of—	Expiration into—	Inspiration is—	Expiration is—
Compressed air.	Compressed air.	Passive.	Active.
“ “	Rarefied air.	“	Passive.
“ “	Atmospheric pressure.	“	“
Rarefied air.	Compressed air.	Active, but expansion is hindered.	Active.
“ “	Rarefied air.	Ditto.	Passive.
“ “	Atmospheric pressure.	Ditto.	“
Air at atmospheric pressure.	Compressed air.	Active.	Active.
Ditto.	Rarefied air.	“	Passive.
Finally, inspiration and expiration of air at atmospheric pressure, as in normal breathing and pulmonary gymnastics.	.....	“	“

It will be seen by examination of these combinations that—

(a) Inspiration of compressed air is always passive and does not strengthen the muscles of inspiration.

(b) Inspiration of rarefied air is active and strengthens

the muscles of inspiration; but the negative pressure of the inhaled air diminishes and hinders chest expansion.

(c) Inspiration at atmospheric pressure is active, strengthens the muscles of inspiration, and there is no hindrance to expansion of chest.

(d) Expiration into compressed air is the only mode which strengthens the muscles of expiration. Practically this is equivalent to interpolating a greater or less resistance to expiration.

I claim, therefore, that voluntary active inspiration of air at ordinary pressure is the best method of securing permanent improvement in the respiratory capacity, because it is the most efficacious in strengthening the muscles of inspiration. This, in substance, is accomplished by supervised pulmonary exercise.

If it is desired to especially strengthen the muscles of expiration and to cause hyperdistention of the air cells, that end may be attained by the use of the resistance valves of S. Solis-Cohen or Dennison, or even the simple breathing tube. The latter is unscientific because there is no means of varying the resistance.

Facilitation of gaseous interchange and certain circulatory effects are claimed for the use of air at varying pressures. Probably these claims are well founded, although the evidence is largely theoretical. Nevertheless, the continuance of the pressure is comparatively so brief that these effects must be evanescent.

I do not wish to be understood as decrying mechanical acrotherapy. I simply desire to state that with the class of cases dealt with in this paper I have obtained distinctly better and more permanent results with voluntary exercise.

The drawback of supervised exercise is obviously the difficulty of securing expert operators. As before stated,

this difficulty does not apply to large cities. With reference to places where no operator resides, it may be affirmed that a physician who makes himself reasonably familiar with the subject can, by spending some time and trouble, train an available and intelligent person to do this work in a satisfactory manner. The practice of physical culture in the schools is fortunately spreading so rapidly that there are few towns of any size that do not contain some person, man or woman, who has given considerable attention to this subject. Such an one is usually willing to undertake medical gymnastics. Demand creates the supply.

In passing, it may be said that well planned supervised exercise is extremely useful in other than pulmonary conditions. I have seen excellent results in beginning lateral curvature, stooping shoulders, improper carriage of the body, awkwardness, psychical or congenital, habitual constipation, and disorders of digestion.

As a sample of exercises\* which may be taken by the patient where supervision is not attainable, I submit these photographs. These exercises are intended for a person not much below the average strength, but the manner of performance may be modified to suit less vigorous individuals.

The photographs are made from a professional model. Each series represents an exercise; each figure, a phase or movement of the exercise. By noting the successive changes of position and contour from left to right, in connection with the text, a very imperfect idea of the exercise and its effects on the thorax and respiratory muscles may be gained. A personal trial of the movements will give a much more vivid realization of their physiological results.

To formulate conclusions:

\* Arranged by Miss Jessie A. Lines, Director of Physical Culture, Pratt Institute, Brooklyn, N. Y.



1. The treatment of phthisis should be broadly comprehensive, but minute in detail.
2. Among many therapeutic agencies for imminent or incipient phthisis, one of the most useful is respiratory exercise.
3. Of all methods of obtaining increase of respiratory strength, capacity, and nutrition, supervised exercise secures the most permanent and lasting results.

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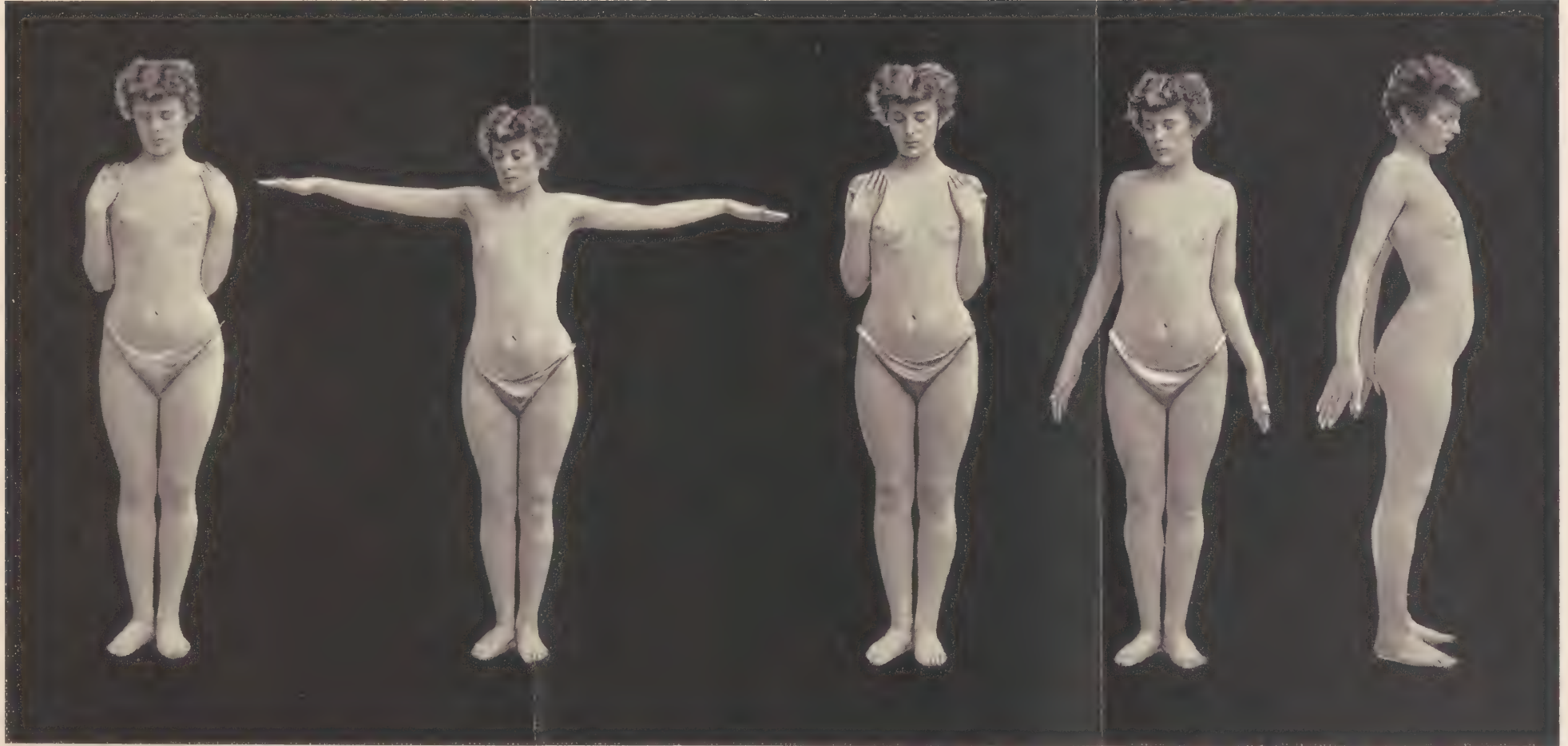
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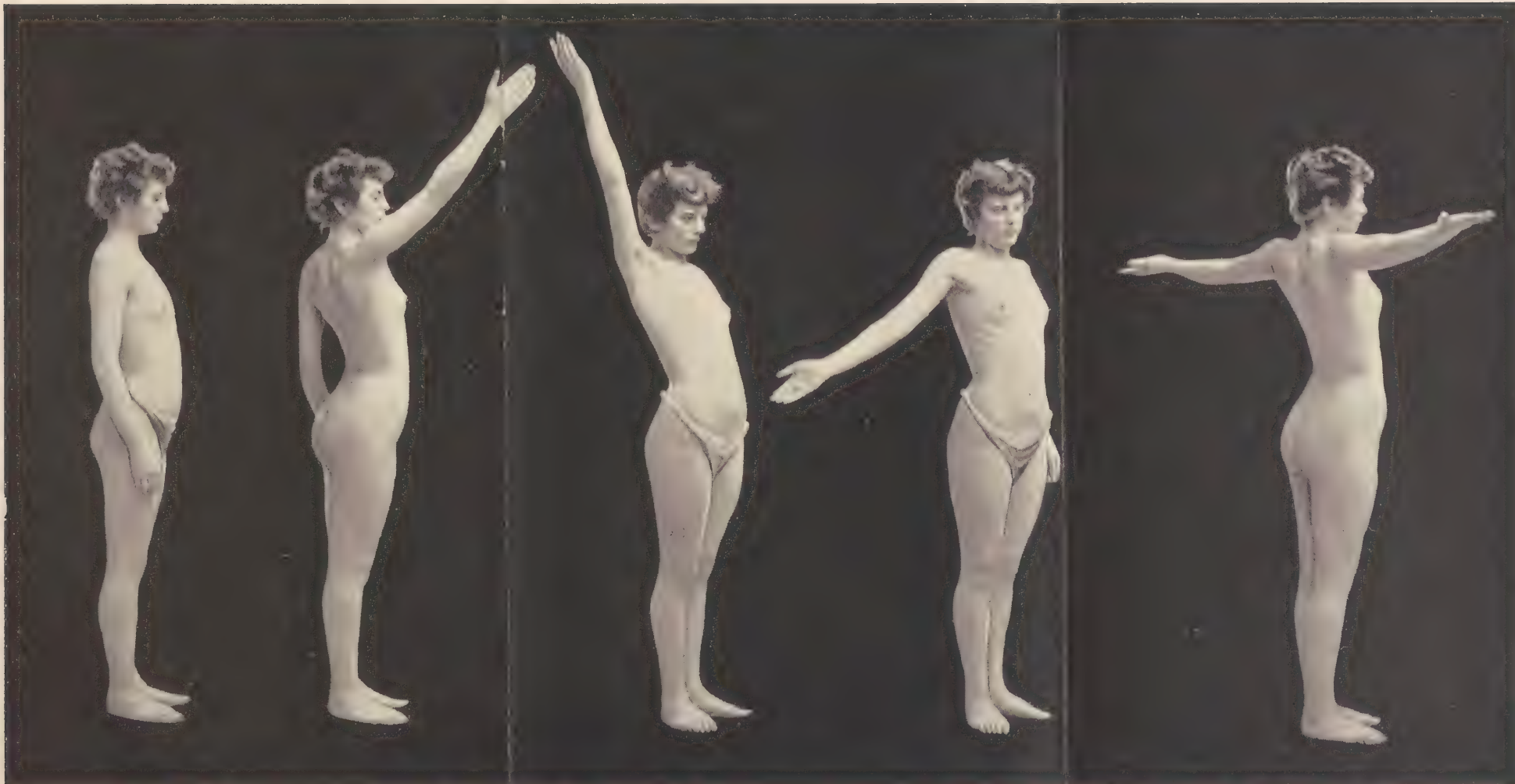
First movement.  
Flex and rotate arms, fingers to  
shoulder, elbows at side.

Second movement.  
Extend arms to side, palms down.

Third movement.  
Flex and rotate arms, fingers to  
shoulder, elbows at side.

Fourth movement—front and side view.  
Hands down and back, extend. Palms midway.

. EXERCISE A.



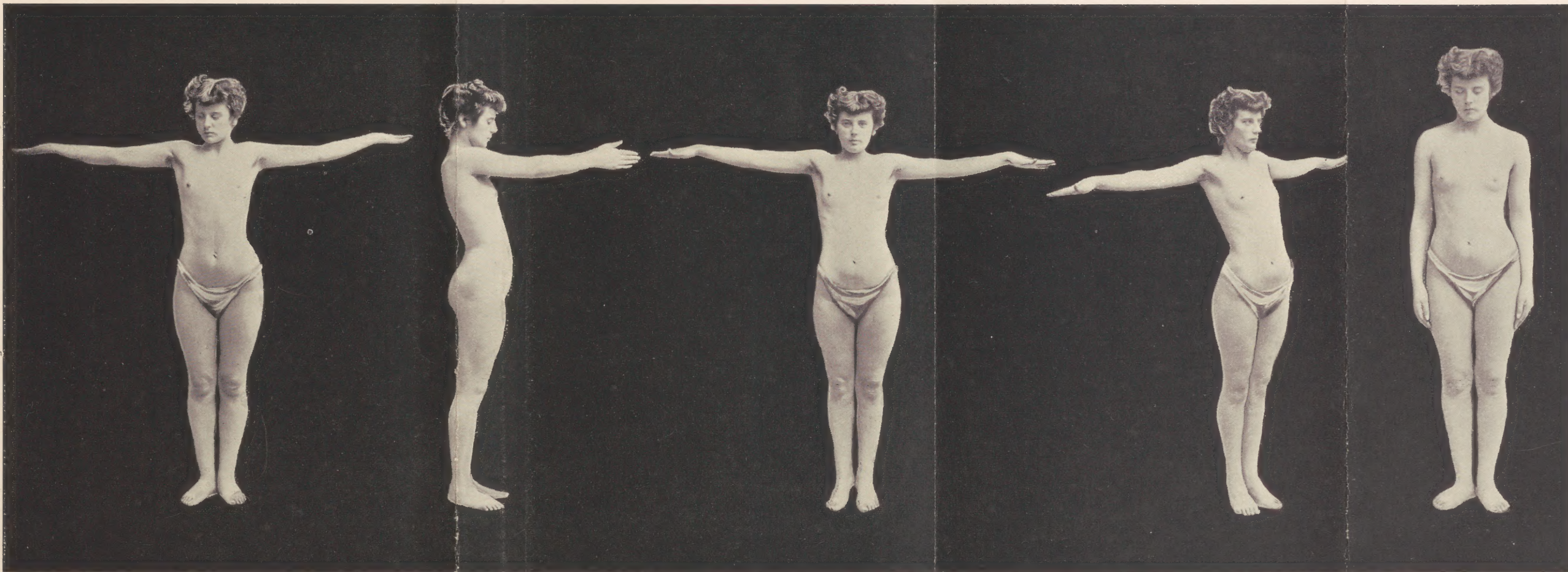
Inhale, hold breath, revolve right arm twice, slowly; exhale.

#### EXERCISE B.

Arms extended to side and back, palms up.  
Grind shoulder-blades, moving hands in  
small circles.

#### EXERCISE C.





First movement.  
Extend arms at side, palms up.

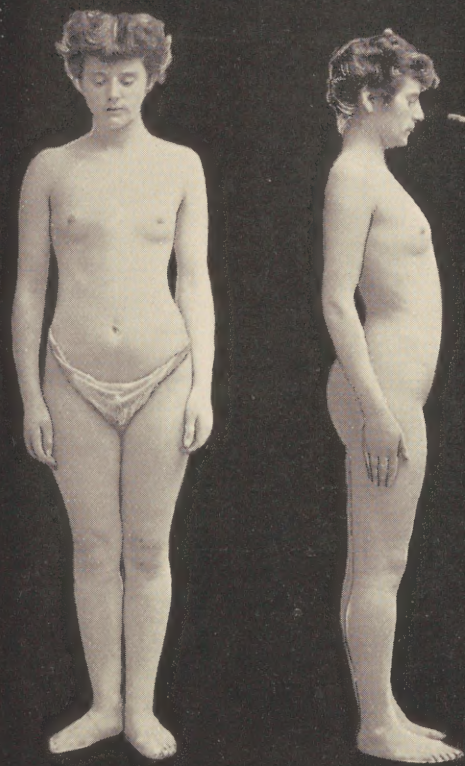
Second movement.  
Palms together in front of body,  
shoulder high.

Third movement—front and three quarters view.  
Rise on toes, inhale; extend arms to side, and back as far as possible.

Fourth movement.  
Arms down, exhale, down on  
heels.

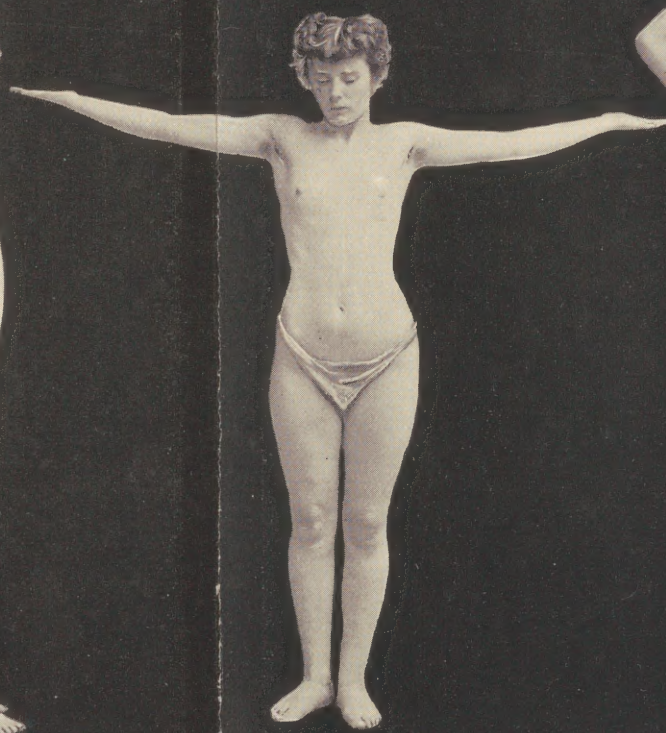
# EXERCISE D.



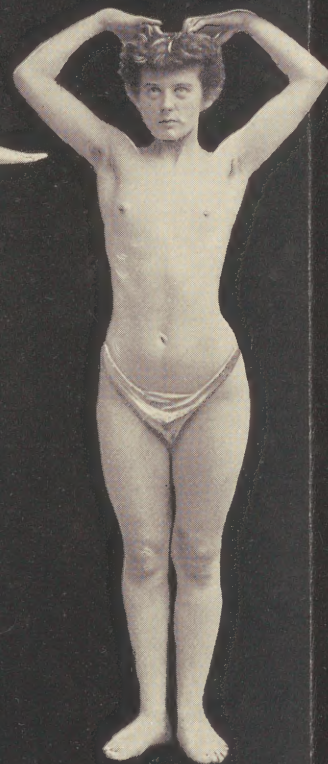


Heels together, knees touching, toes out, chest out,  
chin in, arms hanging naturally.  
Front and side view.

CORRECT STANDING POSITION.



First movement.  
Extend arms at side, palms up.



Second movement.  
Arms up, touching fingers  
over head.



Third movement.  
Clap hands over head,  
full length up.



Fourth movement.  
Arms down to side.

EXERCISE E.



# The New York Medical Journal.

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THE PHYSICIAN who would keep abreast with the advances in medical science must read a *live* weekly medical journal, in which scientific facts are presented in a clear manner; one for which the articles are written by men of learning, and by those who are good and accurate observers; a journal that is stripped of every feature irrelevant to medical science, and gives evidence of being carefully and conscientiously edited; one that bears upon every page the stamp of desire to elevate the standard of the profession of medicine. Such a journal fulfills its mission—that of educator—to the highest degree, for not only does it inform its readers of all that is new in theory and practice, but, by means of its correct editing, instructs them in the very important yet much-neglected art of expressing their thoughts and ideas in a clear and correct manner. Too much stress can not be laid upon this feature, so utterly ignored by the “average” medical periodical.

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